SECTION 714
PAVEMENT MARKING MATERIALS

714.01 TEMPORARY PAVEMENT MARKING TAPE. Furnish temporary pavement marking tape that is 4-inch (105 mm) wide, retro-reflective, pressure-sensitive tape specifically manufactured for use as pavement stripping. The tape must be available in white and yellow.

714.02 TEMPORARY PAVEMENT MARKING TABS. Furnish temporary pavement marking tabs meeting the following:

1. Types I and II: "L" shaped, extruded polyurethane, at least 4-inches (105 mm) wide by 2-inches (50 mm) high with a reflectorized strip meeting requirement No. 4 below; attached horizontally across the top of the vertical portion of the tab; an adhesive strip meeting requirement No. 5 below;
2. Type I tabs: white reflectorized tape on one side with white bodies;
3. Type II tabs: yellow reflectorized tape on both sides with yellow bodies;
4. A minimum tape reflectance of 1200 candlepower per square foot (138,892 lux per m^2) at 0.1 degrees observation and 0.0 degrees entrance angles;
5. An adhesive strip at least ¾-inch wide by ⅛-inch thick (19 mm X 3 mm) on the tabs underside;
6. A cover protecting the reflective strip that will not come off under traffic but is manually removable.

714.03 PREFORMED PLASTIC PAVEMENT MARKING MATERIAL.

714.03.1 Composition Requirements. Furnish preformed plastic pavement marking material consisting of plastics and plasticizer's, pigments, and reflective glass beads combined and proportioned to meet the following:

1. Available in both yellow and white color;
2. The total pigment in white marking material a minimum 20% by weight titanium dioxide;
3. The total pigment in yellow marking material a minimum 18% by weight medium chrome yellow;
4. Marking material colors that match the Federal Standard Highway Color #595 A, 33538 for yellow, 37925 for white;
5. Non-yellowing white material;
6. non-fading yellow material during the expected life of the materials;
7. Having reflective glass beads meeting Subsection 714.05 requirements uniformly distributed throughout the entire material.

714.03.2 Adhesive Requirements. Furnish material having a pre-coated pressure-sensitive adhesive on the base to adhere to bituminous and portland cement concrete pavements. The adhesive must:

1. Be sufficiently free of tack so the material can be handled or repositioned on the pavement before being permanently fixed in position;
2. Mold to the pavement contours, breaks, faults under traffic at normal pavement temperatures;

3. Reseal itself so that, under normal use, it will fuse with itself and previously applied markings of similar composition;
4. Capable of being inlaid in pavement at temperatures up to 275 °F (135 °C);
5. Not lose its adhesive and reflective properties when exposed to water used in rolling operations.

714.03.3 Dimensional Requirements. Furnish the pavement marking material in standard manufactured widths of 4, 6, 8, 12, and 24-inches (105, 155, 205, 305, & 610 mm).

Furnish the material for words and symbols in pre-cut configurations matching the shapes and dimensions specified in the publication "Standard Alphabets for Highway Signs and Pavement Markings".

Furnish the pavement marking material in the thickness specified in the Contract.

Cut the edges of plastic pavement marking material clean and true.

714.03.4 Physical Requirements.

A. **Tensile Strength.** Furnish plastic material having a minimum tensile strength of 40 psi (276 kPa) when tested under ASTM D 638. The break resistance is based on an average of at least 3 samples tested at a temperature of 70 °F-80 °F (21 °C-27 °C) using a jaw speed of 0.25-inch (6 mm) per minute.

B. **Plastic Pull Test.** A 1 by 6-inch (25 X 155 mm) sample of the plastic material must support a dead weight of 0.66 pounds per 0.01-inch (1.2 kg per mm) of material thickness for at least 5 minutes at a temperature of 70 °F-80 °F (21 °C-27 °C).

C. **Bend Test.** At 80 °F (27 °C) bend a 3 by 6-inch (75 X 155 mm) sample over a 1-inch (25 mm) diameter mandrel until the end faces are parallel and 1-inch (25 mm) apart. The sample must not show any fracture lines in the uppermost surface under unassisted visual inspection.

D. **Skid Resistance.** The plastics surface friction properties must be at least 35 BPN when tested under ASTM E 303.

E. **Reseal Test.** The plastic must re-seal itself without adhesives when tested as follows: Overlap two 1 X 3-inch (25 X 75 mm) pieces face-to-face forming a single 1 X 5-inch (25 X 130 mm) piece with a 1 square inch (645 mm^2) overlap in the center. Place the 1 X 5-inch (25 X 130 mm) piece on a hard surface with a 1000-gram weight resting uniformly on the entire overlap area and maintain at 140 °F-190 °F (60 °C-88 °C) for 2 hours. Maintain the temperature within the specified range. Cool to room temperature. The pieces must not separate without tearing.

F. **Reflectivity.** Meet the reflective values listed in Table 714-1. Reflective values will be measured on a 2 X 2½ foot (610 X 762 mm) panel under the Instrumental Photometric Measurements of Retro-reflective Materials and Retroflective Devices, Federal Test Method Standard 370.

TABLE 714-1
MINIMUM SIA* (CANDELAS PER FOOTCANDLE PER SQUARE FOOT (M^2))
PLASTIC PAVEMENT MARKING MATERIAL

Observation Angle	Entrance Angle	White	Yellow
0.2°	86°	0.20 (2.1)	0.15 (1.6)
0.5°	86°	0.15 (1.6)	0.10 (1.0)

* SIA - Specific Intensity Per Unit Area

714.03.5 Samples. Submit a 4-inch by 1 foot (105 X 305 mm) sample from each lot of material proposed for use on the project to the Materials Bureau for approval. Obtain approval before using in the work.

714.03.6 Certification. Submit to the Project Manager the manufacturer's certification meeting Subsection 106.03. Include evidence from the manufacturer that the material proposed for use in the work has performed successfully under similar climatic conditions and traffic usage. This evidence of successful use is required for the product to be approved for use.

714.04 TRAFFIC LINE PAINT.

714.04.1 General. The class, type, and brand of paint ingredients is the manufacturers option. Samples of the ingredient materials may be required by the Project Manager. All materials must meet the applicable ASTM specifications and the following requirements.

714.04.2 Manufacture. Grind and mix the ingredient materials to produce a homogeneous paint, free of deleterious material. Furnish to the Department's inspector, the manufacturer's equipment and paint manufacturing process.

714.04.3 Analysis. Furnish 3 notarized copies of the paint analysis and manufacturer's certification under Subsection 106.03. The analysis must state the complete composition and percentages of each of the raw materials in the paint. Formulation's are treated confidentially and are not released without the manufacturers consent.

714.04.4 Pigment. Use inorganic colors and white pigment to produce the specified yellow.

Yellow paint, less beads, must contain at least 1.5 lbs per gallon (0.18 kg/L) total chromium as $PbCrO_4$ in the form of medium chrome yellow type **III**. Chromium content is determined by chemical analysis of the extracted pigment.

White paint, less beads, must contain a minimum of 1.5 lbs per gallon (0.18 kg/L) titanium dioxide as determined from the chemical analysis of total titanium dioxide in the extracted pigment.

714.04.5 Vehicle. Use an alkyd resin meeting the following specifications:

Nonvolatile	59-61%
Volatile	Mineral spirits or VM&P naptha
Viscosity (Gardner Holdt)	z-z-4
Acid No. of Solution	10 Max.
Color (Gardner 1933 Std.)	9 Max.
Specific Gravity of Solution	.920-.950

The non-volatile vehicle must be an alkyd resin consisting only of :

Polyhydroxyl Alcohol	15-21%
Phthalic Anhydride	30-40%
Drying Oil Acids	45-60%

The resin must:

1. Not exceed 1% unsaponifiable matter by weight;
2. Must show a negative resin test and a negative phenolic compound test;
3. Limit the drying oils to linseed and /or soybean oil.

714.04.6 Color. A standard color chip will be furnished each bidder for the yellow and white traffic line paint upon request.

714.04.7 Testing. Paint is tested by ASTM, Federal Test Method Standard No. 141, or alternate tests approved by the Engineer.

Meet the following test results:

- **A. Viscosity** — 70 (±5) Krebs Units after 4 days from manufacture at 77 °F (25 °C) and less than 90 Krebs Units at 41 °F (5 °C) when tested under ASTM 562.
- **B. Drying Time** — When tested under Federal Test Method Standards 141C, method 4061.2, no pickup after 10 minutes and before 30 minutes and dry hard within 1 hour.
- **C. Bleeding** — no bleeding or discoloration.
- **D. Water Test** — no blistering, peeling, or wrinkling.
- **E. Flexibility** — no cracking.
- **F. Adhesion** — no cracking, chipping, or peeling.
- **G. Fineness** — greater than 3 when tested using the North Standard Fineness Gauge.
- **H. Skinning** — no skinning in a half-filled pint (0.47 L) container in under 24 hours.
- **I. Settling** — no settling or caking in the container during extended storage. An accelerated evaluation method is included in the test.
- **J. Abrasion** — no paint film loss exceeding 1/10 gram per 1000 revolutions using the Taber Abrasion Test.
- **K. Hiding** — completely hide black when applied at 1 gallon per 175 square feet (0.23 L per m^2).
- **L. Film Appearance** — Dry to a flat finish.
- **M. Light Resistance** — Yellow paint must not darken.

714.04.8 Sampling and Acceptance of Materials. Traffic paint is sampled from the striping machine paint tank, before work begins, at the point of application.

Draw samples, when directed, in sample containers furnished by the Inspector. Furnish all required assistance for sampling. Samples not witnessed by the Inspector are not acceptable for testing. Paint not meeting the specifications cannot be used in the work.

714.04.9 Packaging and Marking. Ship paints in the paint manufacturer supplied containers. Damaged paint containers received at the project site will be rejected. Assure each container is labeled with the name and address of the manufacturer, shipping point, trademark or trade name, kind of paint, formula or formula number referring to manufacturer's guaranteed formula, number of gallons (liters), date, and batch numbers.

714.05 REFLECTIVE GLASS BEADS.

714.05.1 General. Furnish glass beads for drop-on reflectorizing traffic paint that are spherical and transparent with a smooth, lustrous surface. The delivered beads must be free from extraneous material and bead clumps that do not easily break up while handling and distributing onto the stripe.

714.05.2 Imperfections. The glass beads must:

1. Not contain more than 25% irregularly shaped particles when tested under ASTM D 1155;
2. Not be scratched, pitted, milky, contain dark particles, or excessive air bubbles.

714.05.3 Color. The glass beads must not impart a noticeable daytime hue to white pavement markings.

714.05.4 Chemical Stability. The beads must withstand refluxing in distilled water in a Soxhlet extractor for 90 hours without noticeable dulling of the surface luster and not more than 2.5% loss in weight.

714.05.5 Index of Refraction. The glass from which the beads are manufactured must have a minimum refraction index of 1.50 by the immersion method using tungsten light.

714.05.6 Gradation. Meet the following gradations when tested under ASTM D 1214.

Sieve No:	Percent Passing
20 (0.850 mm)	100%
30 (0.600 mm)	75-95
50 (0.300 mm)	15-35%
100 (0.150 mm)	0-5%

714.05.7 Packaging and Marking. Package glass beads in moisture-proof containers marked to identify the contents, manufacturer, lot number, batch number and net weight.

714.05.8 Samples. Glass beads will be sampled for acceptance at the source of supply. The Contractor is to make sample arrangements with the Materials Bureau in Helena, (406-444-6298). The Department will issue the test results, identifying each lot or batch tested, and identifying each lot or batch as acceptable or unacceptable. The Project Manager will provide, upon request, a list identifying the acceptable lots or batches that may be used in the work.

714.06 REFLECTIVE THERMOPLASTIC PAVEMENT MARKINGS.

714.06.1 General. Furnish white and yellow thermoplastic marking material that is hydrocarbon-based. Meet AASHTO M 249 except as modified and supplemented herein.

714.06.2 Color. Furnish yellow marking material matching color chip 33538 of Federal Standard No. 595a, Table 5.

Furnish white marking material matching color chip 37875 of Federal Standard No. 595a, Table 9.

White material must have no tint or coloration after weathering.

714.06.3 Glass Beads. Furnish glass beads meeting Subsection 714.05 requirements.

Submit to the Project Manager, a manufacturer's certification under Subsection 106.03 that the glass beads supplied meet specifications.

714.06.4 Spraying Consistency. Applying Hot Thermoplastic marking material by spraying must be not adversely effect the specified reflectivity, durability, color, line and edge quality, tolerances, thicknesses, and bonding requirements.

714.06.5 Requirements for Hydrocarbon-Based Materials. Meet AASHTO M 249 requirements for hydrocarbon-based thermoplastic marking material, modified and supplemented as follows:

- **A. Specific Gravity.** Cannot vary from the manufacturer's product specification by more than 0.05.
- **B. Composition.** Table 1, Composition, of AASHTO M 249 is replaced with Table 714-2.

TABLE 714-2
COMPOSITION

COMPONENT	WHITE	YELLOW
Binder, Hydrocarbon Base	16.0% min.	16.0% min.
Glass Beads	25% min.	25% min.
Titanium Dioxide	Anatase 5.0% min Rutile	-------
Calcium Carbonate and Inert Fillers	5.0%min 42% max.	-------
Yellow Pigments	--------	See Note

Note: The quantity of yellow pigments, calcium carbonate, and inert fillers is the manufacturer's option providing all other requirements of this specification are met.

Furnish a manufacturer's certification under Subsection 106.03 that the titanium dioxide contains a minimum of 5.0% each of anatase and rutile for all batches of material supplied on the project.

C. Modifications. The following modifications are made to Subsections 4.3, 5., and 6. of AASHTO M 249:

4.3 Physical Characteristics: 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.3.6, 4.3.7, 4.3.9 Wherever the temperatures "211° ± 7°C (412.5° ± 12.5°F)" and "218° ± 2°C (425° ± 3°F)" appear in the above-listed subsections, add "or the manufacturer's recommended application temperature range".

4.3.4 Change "-9.4° ± 1.7°C (15° ± 3°F)" to "-20°C (-4°F)". Add to the last sentence: "after being exposed to ambient room temperature of 20°-23°C (68°-74°F) after cooling."

4.3.5 Change 218° ± 2°C (425° ± 3°F) to manufacturer's recommended application temperature.

5. Application Properties: 5.1 After "211° ± 7°C (412.5° ± 12.5°F)" add "or as recommended by the manufacturer".

6. Packaging and Marking: 6.1 Rescind the last sentence and replace with the following: "The label shall show the manufacturer's recommended application temperature range".

714.06.6 VACANT.